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THIRD-YEAR RESULTS OF EXPERIMENTS IN REFORESTATION OF CUTOVER AND BURNED SPRUCE LANDS IN THE SOUTHERN APPALACHIANS

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Progress Report II

By

Leon S. Minckler, Silviculturist

The first progress report[1/] of planting research in the spruce type of the southern Appalachians contained a brief review of the background for the planting problem and showed that of 20 coniferous species only red spruce, red pine, southern balsam fir, and Norway spruce should be considered for reforestation. The greatest obstacle to successful planting was the dense cover of vegetation on many sites. The chief planting problem sites were: (a) areas of dense herbaceous and shrubby vegetation, (b) young stands of undesirable, brushy hardwoods such as fire cherry, and (c) severe and rocky sites with most of the original organic soil burned away.

Third-year results have confirmed some of the earlier trends and permit further recommendations for the reforestation of cutover and burned spruce lands. The third-year results will be considered by problem sites.

1/Minckler, Leon S. Preliminary results of experiments in reforestation of cutover and burned spruce lands in the southern Appalachians. Appalachian For. Expt. Sta. Tech. Note 47. 1941.

THIRD-YEAR RESULTS OF EXPERIMENTS

Sites with Dense Herbaceous and Shrubby Vegetation

Vegetation on these sites is chiefly ferns or weeds, blackberry vines, and low shrubs up to 5 feet tall with a density of 0.9 or more (90 percent or more of the ground shaded by plants higher than the planted trees). Typical examples are shown in Figures 1 and 2. Results on these sites are based on 150 planting plots and 70 direct-seeding plots on the Monongahela and Pisgah National Forests. Half of each plot was planted or seeded to red spruce and half to red pine. The summary of results and conclusions from the third-year data are as follows:

(1) By the end of the third year the direct seeding of spruce was a virtual failure and that of pine only a partial success. Screened seed spots on the Monongahela, seeded in 1940, were 61 percent successful for red pine and 10 percent for spruce. Spring and fall seedings on the Pisgah for both spruce and pine were failures as were also the 1941 spring seedings on the Monongahela. The chief causes of failure were frost-heaving, suppression by competition, and, in 1941, the extreme spring dryness.

(2) The success[2/] of planted 2-1 red spruce was greatly superior to planted 2-1 red pine on these sites. On the Pisgah the best treatment for pine gave 83 percent success and the average of all treatments was 45 percent. For spruce the maximum was 90, and the average, 59 percent. On the Monongahela the best treatment for red pine gave 64 percent success, and the average of all treatments was 55 percent. For spruce the maximum was 84 percent, and the average, 72 percent. Spruce was superior to pine for the check and for every treatment on both forests. It is recommended that red pine be planted only on rather exposed sites with predominantly mineral soil and moderately sparse vegetation. Sites with dense cover and predominantly organic soil should be planted to red spruce.

(3) The release of the planted trees during early July of the first season by cutting the competing vegetation for a radius of 1-1/2 to 2 feet around each tree was the best treatment. The comparison between the released and check plots is given in Table 1.

(4) The success of "super" planting stock depended upon the basis for its selection. Stock selected on a basis of size alone was only slightly better than the check, and much poorer than released plots. In 1941, stock was selected on the basis of stem caliper and root balance. This stock was planted only on the Monongahela. For spruce, success was second only to the release treatment and for pine somewhat better than the released plots.

2/The percentage of all trees planted which were thrifty. An unthrifty tree is one judged likely to die within a year.

Table 1.--Success and growth of released plots[1/]

Species and Forest	Success		Growth[2/]	
	Released plots	Check plots	Released plots	Check plots
	Percent	Percent	Feet	Feet
Red spruce:				
Monongahela	84	69	0.36	0.18
Pisgah	90	58	0.41	0.27
Red pine:				
Monongahela	64	51	0.41	0.24
Pisgah	83	44	0.51	0.29

1/Based on a total of 48 plots for each species.
2/Growth of all live trees the 2nd plus the 3d seasons.

For growth, however, the super stock plots were only about 60 percent as good as released plots. Nursery run stock at the U. S. Forest Service Nursery, Parsons, West Virginia, would yield about 10 percent super stock.

(5) Broadcast burning before planting on the blackberry-fire cherry type of the Pisgah was the second best treatment for spruce but had no advantage for pine. Success was 72 percent as compared with 58 for the check. Burning of fern and weed cover on the Monongahela was ineffective. General observations in the spruce type have indicated that some combination of burning and grazing may be the cheapest and best method of site preparation for spruce planting.

(6) The one remaining treatment better than the check was the preparation of a 3-foot planting spot where roots were cut and eradicated. Success was only 10 percent better than the check, and the cost was prohibitive.

(7) Both the use of a complete fertilizer, and Hormodin A and Transplantone vitamin-hormone root stimulation gave results poorer than the check. Plots with fertilizer placed in the planting hole rather than beside the hole gave especially poor results. A 3-foot superficial scalp was no better than an 18-inch scalp.

(8) No significant differences in plantation success were found on the various cover types. Density of vegetation rather than species is the important factor. The proportion of planted trees covered by dead vegetation, however, was different for the 3 types (Table 2). Because of lack of

Figure 1.--Bracken fern. Relative height shown by foot rule. West Virginia.

Figure 2.--Planted red pine and its competition of bracken fern and blackberry. West Virginia.

Vertical profiles of characteristic dense vegetation. Such sites cannot be successfully planted without some means of reducing competition.

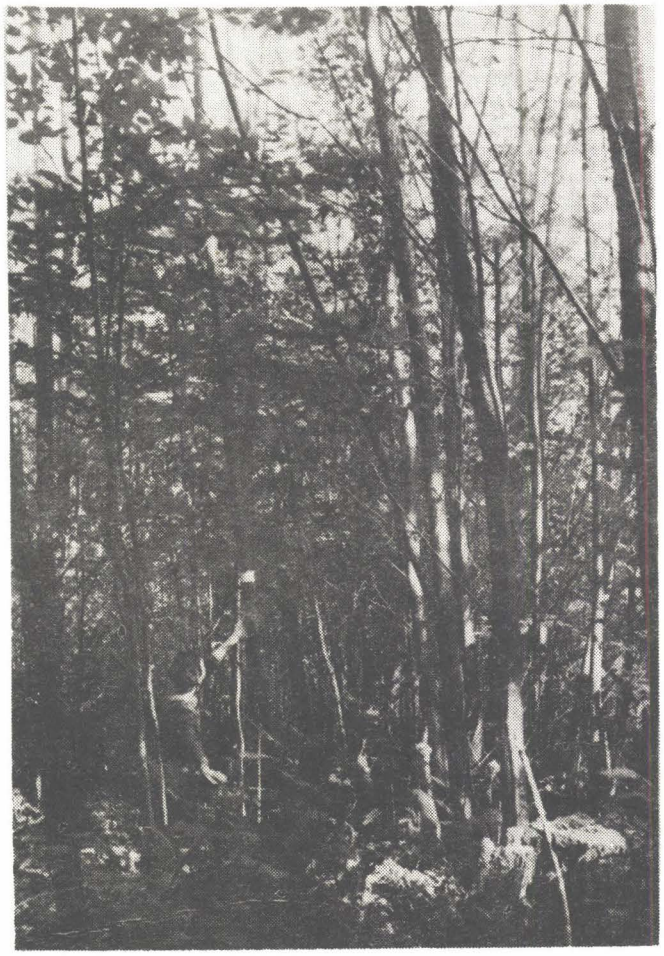

Figure 3.--Dense stand of fire cherry with light ground cover of blackberry and weeds. North Carolina.

Figure 4.--Mixture of fire cherry, sassafras, red maple, holly, alder, and brushy birch. West Virginia.

Typical stands of undesirable hardwoods. There is no seed source of timber species and the thin rocky organic soil on most sites precludes the success of any species except red spruce. Planting will not be successful unless competition is greatly reduced.

Table 2.--Covering by dead vegetation - Monongahela plots

Vegetation type	Percent of all live trees covered by dead vegetation at end of third year	
	Red spruce	Red pine
Bracken fern	18	9
Bracken fern-fire cherry	8	3
Blackberry-fire cherry	5	3

fern on the Pisgah plots, covering of planted trees was practically absent. Most of the covering on the blackberry-fire cherry type on the Monongahela plots was caused by the bracken fern mixed with the blackberry.

(9) Two blocks on a creek-bottom site with extremely dense blackberry, bracken fern, and fire cherry cover were virtual failures for all treatments. The average third-year success for spruce was 41 percent and for red pine 11 percent. The best treatment was super stock selected on the basis of caliper and root-top ratio. With the possible exception of burning and grazing probably the only way to obtain planting success with spruce on such sites is by use of super stock plus release the first, third, and possibly the fifth years. The planting of red pine should not be attempted on these sites.

Sites with Young Stand of Undesirable, Brushy Hardwoods

Final recommendations for the underplanting of undesirable hardwoods with spruce cannot yet be given. On these sites, pictured in Figures 3 and 4, vegetation is chiefly fire cherry or red maple, deciduous holly, sassafras, sumac, rhododendron, and yellow birch, more than 5 feet tall with a density of 0.7 or more. The following tentative conclusions are offered:

(1) In stands of high[3/] and medium[4/] density the planted trees must be released early the first summer after planting by making 8- to 12-foot openings in the overstory canopy. In stands of high density, unreleased planted

3/Fire cherry 20 to 40 feet tall with a moderately dense understory of blackberry. These conditions occur mostly on the Pisgah plots.

4/Mixed stands 15 to 30 feet tall of red maple, fire cherry, deciduous holly, alder, sassafras, rhododendron, and birch with little ground cover. These conditions occur mostly on the Monongahela plots.

Figure 5.--A severe rocky site with very thin soil and sparse vegetation. Most of the original organic soil has been burned away. It is possible that seed-bearing trees can be grown in soil pockets. West Virginia.

Figure 6.--A plantable site. The fern-fire cherry cover is not too dense for successful planting without special treatment. Although thin, this soil will support red spruce. Tennessee.

spruce was only 14 percent successful after 3 years, and on medium density plots, 44 percent.

(2) In stands of high density (Fig. 3), release the first summer only will not be sufficient to insure a satisfactory stand. By the end of the third year 50 percent of the planted and released trees were either dead or definitely unthrifty. On such sites, release the first and third summers and two subsequent releases would probably be necessary.

(3) In stands of medium density (Fig. 4), release the first and fifth summers with possibly one additional release would probably suffice.

(4) In stands of low density[5/] 63 percent of unreleased trees were still thrifty after 3 years, and for trees released early the first summer, 75 percent were thrifty. On these sites one release would probably be enough but it is not yet determined whether this should come the first, third, or possibly fifth summer.

(5) In high density stands, release openings 10 to 12 feet in diameter were definitely superior to 5- to 7-foot openings, but in medium and low density stands there was little difference.

Stands of large fire cherry on good sites with an understory of blackberry as shown in Figure 3 respond to cutting for release in an unfortunate way. The openings tend to fill up with an even denser growth of blackberry vines. The same occurs when the short-lived fire cherry trees begin to die. Thus, in the absence of a good spruce or other seed source, a rotation of blackberry, fire cherry, and blackberry again tends to develop. To restore spruce to such an area would require an expensive series of releases unless it can be shown that burning combined with rather heavy grazing would effectively prepare such sites for planting. The probable alternative, on large areas, is 500 to 1,000 years or more of brush, or at best, birch and red maple of very inferior quality.

Severe and Rocky Sites

Planting red spruce or southern balsam fir in the soil pockets on severe and rocky sites offers no difficulty. On these sites most of the original humus soil has been burned away and the vegetation density is usually less than 0.4. Such a site on top of Black Mountain, near Marlinton, West Virginia, is pictured in Figure 5. The use of super stock, fertilizer, or vitamin-hormone root stimulation had no marked advantage over regular

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5/Mixtures of scattered fire cherry, red maple, deciduous holly, alder, sassafras, rhododendron, and brushy birch mostly 5 to 20 feet tall and with a moderate ground cover of fern, weeds, or moss. These conditions occur mostly on the Monongahela plots.

planting procedure. The spruce had definitely better success than the balsam, but this was caused by the inferior quality of the balsam planting stock. The average success for spruce was 82 percent and for balsam, 64 percent.

Direct seeding of spruce and balsam in small prepared spots with spots lightly mulched and screened was relatively successful. A 5-7-5 fertilizer and the use of "osmo" paper cups filled with top soil showed no advantage for spruce but each increased the success of balsam. By the end of the third year success on plots where the screens had been left in place was considerably greater than where screens had been removed at the end of the first year (Table 3). The much greater success of direct seeding on this site than on the lower and heavily vegetated sites was caused by (a) less frost-heaving, (b) virtual absence of competing vegetation and (c) more moist conditions. The reduction in frost-heaving was probably the result of a rather constant frozen condition during the winter instead of the frequent freezing and thawing at lower elevations.

Table 3.--Third-year success[1/] of direct seeding in prepared spots - severe and rocky sites

Species	Mulched and screened		Fertilized, mulched and screened		Fertilized "osmo" cups, mulched and screened	
	Screened 3 years	Screened 1st year only	Screened 3 years	Screened 1st year only	Screened 3 years	Screened 1st year only
	Percent	Percent	Percent	Percent	Percent	Percent
Red spruce	60	48	51	41	53	42
Southern balsam fir	60	46	72	54	76	58

1/Percent of spots having one or more live seedlings.

The initial establishment of spruce or balsam on these sites by either planting or seeding is apparently easily accomplished. The question, however, is whether the thin rocky soils will support tree growth to a seed-producing age. The direct-seeded trees, with their more natural root systems should have the advantage in this respect.

GENERAL RECOMMENDATIONS

Based on the specific information already outlined, and on general observations made in the spruce type, the following general recommendations can be made.

(1) Typical spruce sites characterized by relatively shallow organic soils, a tendency toward podsolization, moist to wet conditions, and a moderate to heavy vegetative cover should be planted to red spruce. Red pine should be planted only on drier, more exposed sites, with a relatively deep mineral soil and sparse to moderate vegetation.

(2) Sites with dense herbaceous and shrubby vegetation and with young stands of undesirable hardwoods should not be planted unless some provision is made for needed release. Release work should be done in late June or early July. This is important for maximum benefit to planted trees and minimum sprouting. Release the first summer is usually essential. The time of subsequent releases will depend on type and density of the cover, as already explained. Sites with blackberry, fern, or similar species as the predominating cover are plantable without release if the density is 0.75 or less. A plantable site is pictured in Figure 6. Sites with cover densities of 0.8 to 0.9 are borderline whereas those with cover density 0.9 or over definitely need release.

(3) Planting sites with extreme conditions of heavy cover will probably require super stock plus release, or regular stock plus frequent and heavy release. Super stock without release should give success on borderline sites; 0.8 to 0.9 density.

(4) Severe rocky sites with thin soils and very sparse vegetation can be successfully planted or seeded in the soil pockets. The limitations of soil will greatly restrict the value of the stand but the object would be the production of seed-bearing trees rather than timber.

(5) A combination of burning and grazing followed by planting is probably the cheapest and most effective treatment for establishing spruce on heavily vegetated sites. This method should be tested on an experimental or pilot plant basis.

(6) Many of the cutover and burned spruce type lands, because of soil and climate, are unfitted for the growth of any timber species except red spruce, southern balsam fir, and red pine. Hardwood species such as fire cherry, red maple, and birch will not produce timber on many of these sites. Unaided by man, nature probably will require 500 to 1,000 years or more to restore these lands to timber. Although complete planting may not be possible or desirable, the establishment of strategically located blocks of seed-source plantations will hasten tremendously the attainment of a timber cover.